

and filtering the first image to generate a second image of the structure. The method may include extracting the second boundary from the second image. The method may include determining the thickness of the first layer based on a determined distance between the first boundary and the second boundary.

[0039] The representation of the first boundary in the original image may be a nonlinear line, and the axis line may extend in a first direction in the first image.

[0040] The first boundary may define a circular shape or an elliptical shape in the original image.

[0041] Generating the second image may include dividing the first image into a plurality of subregions and performing an averaging operation on each of the plurality of subregions to generate a plurality of averaged subregions, such that the second image includes the plurality of averaged subregions.

BRIEF DESCRIPTION OF THE DRAWINGS

[0042] The foregoing and other features of inventive concepts will be apparent from the more particular description of non-limiting embodiments of inventive concepts, as illustrated in the accompanying drawings in which like reference characters refer to like parts throughout the different views. The drawings are not necessarily to scale, emphasis instead being placed upon illustrating principles of inventive concepts. In the drawings:

[0043] FIG. 1 is a flow chart illustrating a method of measuring a thickness according to some example embodiments;

[0044] FIG. 2 is a cross-sectional view illustrating an example of a structure having a first layer to be measured based on the method of measuring the thickness according to some example embodiments;

[0045] FIG. 3, FIG. 4A and FIG. 4B are diagrams for describing an original image used in the method of measuring the thickness according to some example embodiments;

[0046] FIG. 5 is a flow chart illustrating an example of extracting a first boundary in FIG. 1;

[0047] FIG. 6 is a flow chart illustrating an example of converting an original image into a first image in FIG. 1;

[0048] FIG. 7 and FIG. 8 are diagrams for describing the example of converting the original image into the first image of FIG. 6;

[0049] FIG. 9 is a flow chart illustrating an example of generating a second image in FIG. 1;

[0050] FIG. 10, FIG. 11A, FIG. 11B, FIG. 12 and FIG. 13 are diagrams for describing the example of generating the second image of FIG. 9;

[0051] FIG. 14 is a cross-sectional view illustrating an example of a structure having a first layer to be measured based on the method of measuring the thickness according to some example embodiments;

[0052] FIG. 15, FIG. 16 and FIG. 17 are diagrams for describing the method of measuring the thickness according to some example embodiments;

[0053] FIG. 18 is a flow chart illustrating a method of measuring a thickness according to some example embodiments;

[0054] FIG. 19, FIG. 20 and FIG. 21 are diagrams for describing the method of measuring the thickness according to some example embodiments;

[0055] FIG. 22 is a flow chart illustrating a method of processing an image according to some example embodiments; and

[0056] FIG. 23 is a block diagram illustrating an electronic system according to some example embodiments.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0057] Example embodiments will now be described more fully with reference to the accompanying drawings, in which some example embodiments are shown. Example embodiments, may, however, be embodied in many different forms and should not be construed as being limited to the embodiments set forth herein; rather, these example embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of example embodiments of inventive concepts to those of ordinary skill in the art. In the drawings, the thicknesses of layers and regions are exaggerated for clarity. Like reference characters and/or numerals in the drawings denote like elements, and thus their description may not be repeated.

[0058] It will be understood that when an element is referred to as being “connected” or “coupled” to another element, it can be directly connected or coupled to the other element or intervening elements may be present. In contrast, when an element is referred to as being “directly connected” or “directly coupled” to another element, there are no intervening elements present. Other words used to describe the relationship between elements or layers should be interpreted in a like fashion (e.g., “between” versus “directly between,” “adjacent” versus “directly adjacent,” “on” versus “directly on”). As used herein the term “and/or” includes any and all combinations of one or more of the associated listed items.

[0059] It will be understood that, although the terms “first”, “second”, etc. may be used herein to describe various elements, components, regions, layers and/or sections. These elements, components, regions, layers and/or sections should not be limited by these terms. These terms are only used to distinguish one element, component, region, layer or section from another element, component, region, layer or section. Thus, a first element, component, region, layer or section discussed below could be termed a second element, component, region, layer or section without departing from the teachings of example embodiments.

[0060] Spatially relative terms, such as “beneath,” “below,” “lower,” “above,” “upper” and the like, may be used herein for ease of description to describe one element or feature’s relationship to another element(s) or feature(s) as illustrated in the figures. It will be understood that the spatially relative terms are intended to encompass different orientations of the device in use or operation in addition to the orientation depicted in the figures. For example, if the device in the figures is turned over, elements described as “below” or “beneath” other elements or features would then be oriented “above” the other elements or features. Thus, the term “below” can encompass both an orientation of above and below. The device may be otherwise oriented (rotated 90 degrees or at other orientations) and the spatially relative descriptors used herein interpreted accordingly.

[0061] The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of example embodiments. As used herein, the singular forms “a,” “an” and “the” are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms “comprises”, “comprising”, “includes” and/or “including,”